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**Deepening the uncertainty dimension of environmental Life Cycle Assessment: addressing choice, future and interpretation uncertainties.**  
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This thesis is dedicated to the two women of my life, my mother Clemencia and my grandmother Isabel. Mami, you are the personification of determination, courage, perseverance and infinite love. Without your example I would have never pursued a science career. Abue, you are the example of ceaseless action and will to learn. Thanks for showing me that there is always something to learn and that “If you search you will find”. Beyond the two women of my life I want to dedicate this thesis to women in science. Their endeavour to make science accessible to women, made it possible for girls, like me, to pursue a career in science. Hopefully we will be more in the future.

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not see that one coming). What would be of a scientist without the capacity of being critical? Last but not least, David. You literally made the last point of this thesis possible, so I want to finish it with your name. I think we have become poetry together, like that of Bécquer: “What is poetry? you ask, while fixing your blue pupil on mine. What is poetry! And you are asking me? Poetry...is you”. I can't wait for the new adventures to begin! Simply thank you for all, David.



## Curriculum Vitae

María Angélica Mendoza Beltrán was born the 26<sup>th</sup> July 1983 in Bogotá D.C., Colombia. She completed her high school studies at Gimnasio Iragua in Bogota where she also earned the degree of International Baccalaureate in Chemistry, Biology and English in 2000. Between 2001 and 2006 she finalized her studies in Environmental Engineering at University of Los Andes in Bogota. Afterwards she travelled to the Netherlands and earned an MSc degree in Industrial Ecology at Leiden University in 2008. She then worked at the PBL - Netherlands Environmental Assessment Agency, as a junior policy researcher between 2008 and 2012. She worked in topics like reductions of emissions from deforestation and forest degradation (REDD+), international climate policy, climate change scenarios and production-consumption systems analysis. She participated in international modeling exercises such as the Energy Modeling Forum (EMF) and the Representative Concentration Pathways (RCPs) part of the climate scenarios of the Intergovernmental Panel on Climate Change (IPCC) fifth Assessment Report (AR5). In 2013, she became affiliated to the Institute of Environmental Sciences (CML) of Leiden University in The Netherlands, as a leading researcher of the work package on environmental sustainability in the EU FP7 project Increasing Industrial Resource Efficiency in European Mariculture (IDREEM). She worked in collaboration with aquaculture SMEs and research institutes. Between 2014 and 2018 she wrote her PhD thesis on uncertainty in Life Cycle Assessment at CML in Leiden University. Since the end of 2017 and up to present, she has been working at Unilever in the United Kingdom as a sustainability scientist.





## Publications

### Publications in peer-reviewed journals

- 1 Cox, B., C.L. Mutel, C. Bauer, A. Mendoza Beltran, and D.P. van Vuuren. **2018**. Uncertain Environmental Footprint of Current and Future Battery Electric Vehicles. *Environmental Science & Technology* Accepted: acs.est.8b00261. <http://pubs.acs.org/doi/10.1021/acs.est.8b00261>.
- 2 Mendoza Beltran, A., V. Prado, D. Font Vivanco, P.J.G. Henriksson, J.B. Guinée, and R. Heijungs. **2018**. Quantified Uncertainties in Comparative Life Cycle Assessment: What Can Be Concluded? *Environmental Science & Technology* 52(4): 2152–2161. <http://pubs.acs.org/doi/10.1021/acs.est.7b06365>.
- 3 Mendoza Beltran, A., Mutel, C., Cox, B., van Vuuren, D., Font Vivanco, D., Deetman S., Edelenbosch O. Y., Guinée, J. and Tukker, A. When the background matters: Using scenarios from Integrated Assessment Models in Prospective LCA. **Submitted** to *The Journal of Industrial Ecology*.
- 4 Mendoza Beltran, A., M. Chiantore, D. Pecorino, R.A. Corner, J.G. Ferreira, R. Cò, L. Fanciulli, and J.B. Guinée. **2017**. Accounting for inventory data and methodological choice uncertainty in a comparative life cycle assessment: the case of integrated multi-trophic aquaculture in an offshore Mediterranean enterprise. *The International Journal of Life Cycle Assessment*. <http://link.springer.com/10.1007/s11367-017-1363-2>.
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- 6 Villares, M., Isildar, A., Mendoza Beltran, A. and Guinée J. **2016**. Applying an ex-ante life cycle perspective to metal recovery from e-waste using bioleaching. *Journal of Cleaner Production*. Vol 129:315–328. <http://dx.doi.org/10.1016/j.jclepro.2016.04.066>
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- 10 den Elzen, M.G.J., Mendoza Beltran, A., Hof, A., van Ruijven, B. and van vliet, J. **2013**. Reduction targets and abatement costs of developing countries resulting from global and developed countries' reduction targets by 2050. *Mitigation and Adaptation Strategies for Global Change*. Vol 18:491–512

- 11 Chuwah, C., van Noije, T., van Vuuren, D., Hazeleger, W., Strunk, A., Deetman, S., Mendoza Beltran, A. and van Vliet, J. **2012**. Implications of alternative assumptions regarding future air pollution control in scenarios similar to the Representative Concentration Pathways. *Atmospheric Environment*. Vol 79, 787-801. <http://dx.doi.org/10.1016/j.atmosenv.2013.07.008>
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- 19 Boons, F. and Mendoza, A. **2010**. Constructing sustainable palm oil: how actors define sustainability. *Journal of Cleaner Production*. Vol 18. pp. 1686 – 1695.

### Other Publications

- 20 Mendoza Beltran, M.A., F. Pomponi, J.B. Guinée, and R. Heijungs. **2018**. Uncertainty Analysis in Embodied Carbon Assessments: What Are the Implications of Its Omission? In: *Embodied Carbon in Buildings Measurement, Management and Mitigation*, ed. by F Pomponi, C De Wolf, and A Moncaster, 3–21. Springer.
- 21 Hughes, A, Corner, R.A, Cocchi, M., Alexander K.A., Freeman S., Dror A., Chiature M., Gunning D., Maguire J., Mendoza Beltran A., Guinée J., Ferreira J., Ferreira R. and Rebours C. **2016**. *Beyond Fish Monoculture: Developing Integrated Multi-trophic Aquaculture in Europe*. ISBN 9788889407400. Italy. Available at: [http://www.idreem.eu/cms/wp-content/uploads/2016/09/IDREEM\\_FINALREPORT\\_2109.pdf](http://www.idreem.eu/cms/wp-content/uploads/2016/09/IDREEM_FINALREPORT_2109.pdf)

- 22 Arild Angelsen, Caroline Wang Gierløff, Angelica Mendoza Beltrán and Michel den Elzen. **2014**. REDD credits in a global carbon market: options and impact. Nordic Council of Ministers. TemaNord 2014:541.
- 23 Mendoza Beltran, A. and Guinée, J. Goal and Scope Definition for Life Cycle Assessment of Integrated Multi-Trophic Marine Aquaculture Systems. Conference article. LCA Food **2014**. San Francisco. USA.

## Presentations

LCA Food 2014, San Francisco, USA.

- A probabilistic approach to deal with uncertainty due to the methodological choices in LCA.

Aquaculture Europe 14, San Sebastian, Spain.

- Benchmarking life cycle environmental impacts of Integrated Multi-Trophic Aquaculture (IMTA) production: where is the I?

International Society of Industrial Ecology Americas Chapter, Bogota D.C., Colombia.

- Benchmarking environmental impacts of Integrated Multi-Trophic Aquaculture (IMTA) production: accounting for inventory and choice uncertainty in a comparative decision context
- Analyzing the life cycle environmental impacts of Integrated Multi-Trophic Aquaculture using a pseudo-statistical approach to treat choice uncertainty